International Journal of Environment, Ecology, Family and Urban Studies (IJEEFUS)
ISSN (P): 2250-0065; ISSN (E): 2321-0109
Vol. 9, Issue 3, Jun 2019, 111-120

PREDICTION OF MISSING RAINFALL DATA USING ARTIFICIAL NEURAL NETWORK (ANN)

M. LATHA & K. EZHISAI VALLABI

Assistant Professor, Department of Civil Engineering, Annamalai University, Tamil Nadu, India

ABSTRACT

Analysis and design of water resource planning is essential for achieving conclusions for society and other areas. Rainfall data and their availability are important in the design of water survey and water resources projects. Scientists / water trainees face data that is missing for a variety of reasons. Various instrumental / mechanical, manual and random errors of measurement of water variables (rain, steam, etc.). These errors are the most important since the rainfall affects the continuity of the rainfall, and they affect the effects of the water sample using infiltration and use rainfall. Therefore, the data being deleted is an important task in the design of waterway models. Weather forecast is one of the most compelling and demanding operational responsibilities of global meteorological services. Rainfall effect on human civilization is immense. Other than ANN, other models are mathematical or statistical. They may not be written as a function or a formula derived from the samples of their usual varied information, because these models have proven to be accurate, but. The ANN model is based on a "prediction" intelligently "analyzing" the collection of existing large historical data. As a result, real life situations are well understood by "artificial neurons" that can be learned from the experience. The Indian economy is based on rainy season. Data for Indian scientists in the atmosphere is a difficult subject. The project is to create the ANN model to find an average annual rainfall for the rainy season.

Keywords: Trend, Artificial Neurons, Missing Rainfall Data, Artificial Neural Network (ANN) & Hydrologic Model

Received: Apr 23, 2019; **Accepted:** May 13, 2019; **Published:** May 31, 2019; **Paper Id.:** IJEEFUSJUN201914

Original Article

INTRODUCTION

In all types of weather events, the most important role in human life. If it is a natural climate event, its calculation is harder. Weather forecast is one of the most compelling and demanding operational responsibilities of global meteorological services. This is a very complex process, involving many areas of specialization [1]. This is one of the more complicated elements and the water cycle is very difficult to understand because of the wide range of rain and variations due to the large amount of intermittent procedures and understanding of the hazardous patterns of space and temporary scales around the world. Many researchers use a variety of techniques to work out precisely to accurately predict the prediction. The satisfaisant. L'algorithme A is an alternative comparison approach to their high failure failure forecast because of the predictability of the rain due to the nonlinear nature of the behavior, behavior and flow process without any predictability in positive, flexible and data-based learning modeling building [2] app Information and Management need to clear rain water sources. However, rain is caused by a wide range of differences such as space and time due to the large range of vast range of complexity and harder hydraulics. Electromagnetic techniques such as the artificial neural network (ANN) and clear logic (FL) are trained in rainfall. Analysis of sample accuracy is, in general, an ANN model slightly better than PE, RMSE, MAE and accurate LL model [3]. NR method of using missing data is predicted by the use of the communication

system, the synthetic neural network (ANN) and the applicable neuro-fraudulent assumption system (ANFIS). The ANFIS approach gave good results to missing information. The ANN was very useful to predict the missing data than traditional approaches. This analysis confirmed the accuracy of ANN in estimating missing rainfall data [4]. This research encourages the need to compare ANN and LL models. Error levels are comparable to both models. Sample Accuracy Analysis, Overall, AN's model PE performs slightly better than the FL model [5]. The most popular techniques driven by data due to mechanical learning, data mining, soft computing, etc. is a synthetic veins (ANN) [6] network. In this analysis, the water resources management system has an important role to play with rainfall data in the analysis of various systems required for the design. The valuable rain data is valued by artificial composition. Network mode. Historical data from six rain stations located in Maharashtra, Bharat State, have been used to test and train ANN and draw results for improvements made by ANN. Deciding that ANN sample may be useful for estimating missing data [7]. A synthetic neural network (ANN) can be used to predict the conduct of such ethical systems. Most researchers have used ANN successfully in twenty years in this field. The study predicts rainfall forecast for ANN technique is more appropriate than traditional statistics and digital systems. [8] It has produced two rain forecast models in Alexandria in Egypt, the Artificial Neural Network Model (ANN) and the Multi Recovery Model (MLR).. They comparing statistical parameters such as the average square error, the complete error, co-coefficient, and BIAS two models were found to be better than the ANN model MLR model. [9]. This article was created. In Udupi district, Karnataka, India is the ANN model to calculate the average monthly rainfall in India. The three algorithms were finally tested in a multifunctional structure: BPA, Reboot Layer Network (LRN) and Backward Channel Transmission (CBP) and Authors BPA Best Instruction Three [10]. In this study, the Artificial Neural Network (ANN) models were designed to evaluate Ispart's monthly pollution (TMA). The results of ANN and MLR models are comparable with the measured rain rates measured to assess efficiency. Comparisons show that there is a good deal between ANN ratings and rainfall values [11]. Provides detailed analysis and comparison of various neural network structures by using rainy predictions by researchers. While the annual / monthly / daily rainfall uses different neurological networks for calculation, these issues discuss issues. In addition, it provides various precision measures that researchers use to evaluate ANN's performance. [12]. In this study, we test and test a local rainfall forecast based on the Artificial Neural Networks (ANN). Our computer can automatically get weather data used for rainfall polls on the Internet. Weather data from devices installed on a local point is shared among our computer users. The ultimate goal of these studies is to share data on the "large data" practical use and accurate rainfall calculation users on the Internet. [13] In this experiment, rainwater data was tested using two layers of hidden BPNN structures, three different epochs [2-50-10-1, era 500]; [2-50-20-1, Era 1000 and 1500]. Root Pepper Square Error (MSE) is used to measure the functionality of classification. The results showed that the results of the [2-50-20-1, time-limit] 0.00096341 resulted in a good effect. In addition, the BPNN algorithm presented Tenggarong, a good model for predicting rain in East Kalimantan - Indonesia. [14]

Need of the Study

- In water resources planning and management, analysis of water resources models.
- In reservoir operation.
- In Flood warning, flood protection and flood frequency analysis.
- In Runoff Measurements.

Objectives of Study

- Prediction of missing data using ANN.
- Identification of Sensitive meteorological parameters to rainfall.
- Validation of predicted data using error estimates.

Study Area

Annamalai Nagar Research Center is located in Chidambaram town in Cuddalore district of Tamil Nadu. It lies 11 ° and 24 minutes north latitude and 79 degrees 44 minutes east direction, +5,79 m altitude and 4 km² area area. Annual annual revenue yearly annual turnover in October, November and December is 6 m in Annamalai Nagar.

Map showing Study Area

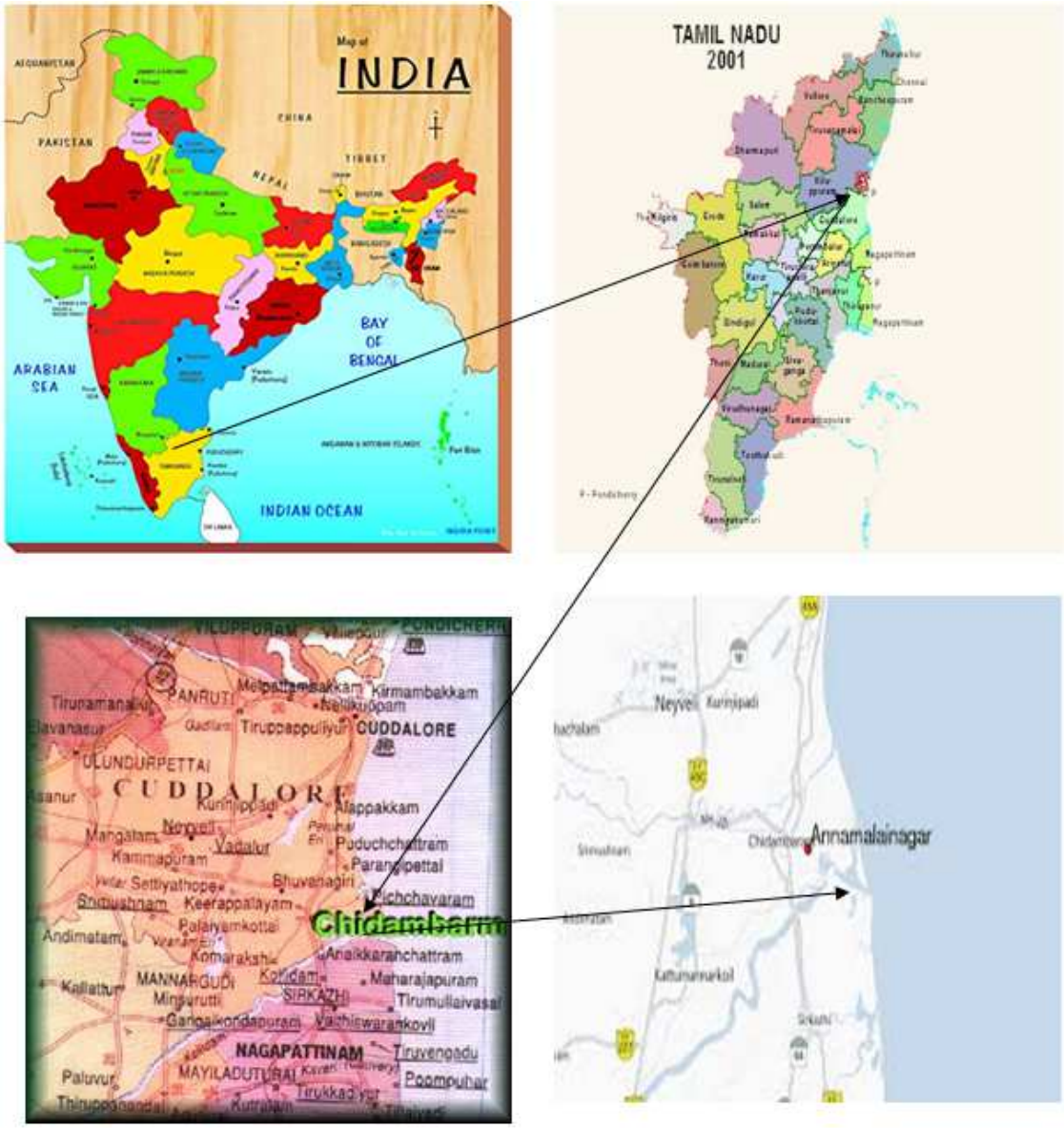

Figure 1

METHODOLOGY

The purpose of this rainfall project is to determine the missing rain information in the early rainy season and the ending of the historical data for the same rainfall. As for the analysis of literature, BPA provides the highest level of consistency and accuracy in targeted data. Therefore, following the following steps is recommended to use multidisciplinary intelligence distribution methodology to predict the missing rainfall in Annamalai Nagar.

- Selection of the input and output data for the supervised BP Learning.
- Normalization of the input and the output data.
- Training of the normalized data using BP learning.
- Testing the Goodness of fit of the model.
- Comparing the predicted output with the desired output

Prediction of Missing Rainfall Using Artificial Neural Network (Ann)

Artificial Neural networks are non-linear mapping structure which is inspired by the observed process of natural networks of biological neurons in brain. It consists of simple computational units called neurons. These are highly inter connected. ANNs become very popular nowadays because of their wide range of applicability and the ease with which it can treat complicated problems.

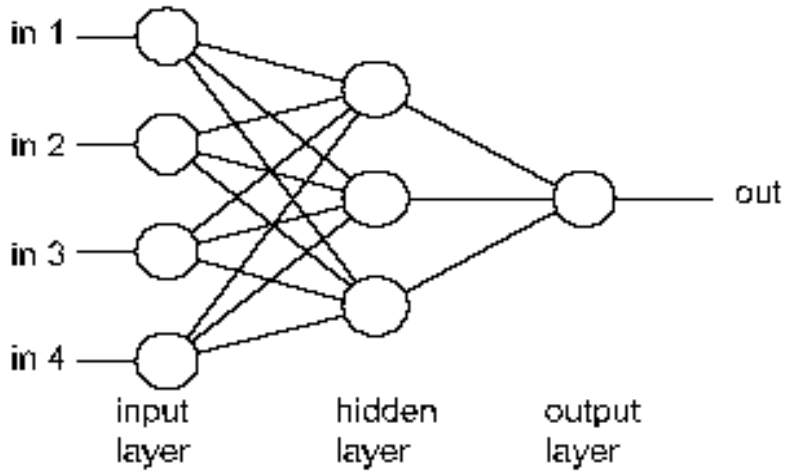

Figure 2: The Schematic Representation of a Artificial Neural Network

Selection of the Input and Output Data

The input parameters considered in this study are Max-Min Temp in°C, Humidity in %, wind speed in Km/h, Sunshine hours Evaporation in mm and month for the Monsoon month Oct-Dec over the period of 18years from 1990 to2008.out put parameter is average monthly monsoon rainfall.

Normalization of Data

The input and output data obtained have to be normalized because they are of different units and otherwise there will be no correlation between input and the output values.

Training of Input Data

After obtaining the normalized data the next step is to train the input data using matlab back propagation algorithm. The network architecture for missing rainfall consists of input nodes and output node. In the present study it consists of 8input nodes and 1 output node. The parameters of choices as input must have an influence on the desired output. In the current study data from 1990-2008 in the monsoon months oct, nov, dec with 6 input parameters per month totally 324 data sets, out of which 252 are training data set and 72 are testing data set used to predict missing data in beginning middle and end points.

Development of ANN Model

ANNs represent an innovative and fascinating solution to the output variables with the introduction of complex systems, and is a common factor in the use of priority neurological technology. The key steps in the development of ANN models define relevant sample entries, specify the network type, and share preprocessing and available data; Determine the structure of the network; Define the sample performance parameters; Training (selection of link weights); Rate the sample.

This study uses retro-energetic, multidrug microbial microbial nerve network (MLP) to establish a continuous reaction model that cannot be used to directly estimate the missing rainfall data. The first step was to determine the number of input layers, hidden layers and output layers; Number of input, hidden and output neurons; The second stage consisted of training algorithms, learning rate, number of revaluations, withdrawing money, and the funding of training.

The hidden layers provide the network with the ability to generalize. In theory, a sufficient number of networks with a hidden layer and network can transform any continuous functionality and reflect a rich and flexible class of global phenomena. Later, this review produces a three-layer insight (TLP) network, with the missing rain, a hidden layer and a layer of output layer.

Experience data packages typically have a different size unit size, and are often carried by measurement errors, noise or interference. These factors can have a negative impact on the functions of ANN drive protocols. In order to avoid these implications, it is necessary to initialize data quality during the initial phase, ie to alter data in a consistent range of data to modify data. This prevents any imagery that spontaneously dominates neural network modeling outputs. Therefore, input data is presented to the default within the bounds of the sigmont logistic function., i.e,.0-1.

The number of water samples (or examples) available for modeling was 324 and the number of input WQVs (neurons) was 6. The 72 samples were divided into training, cross validation (or over-fitting), and testing sets. The testing subset should include data never used in the training and cross-validation sets and this data should constitute approximately 10–40% of the size of the training set.

The number of input and output units is usually fixed, depending on the number of input predictors and output variables. However, determining the number of hidden nodes is usually a trial and error task in ANN modeling. The typical number of hidden nodes is expected to be $\geq 6/3 \approx 2$ neurons and $\leq 6\times 4 = 24$ neurons ($2\leq Nh \leq 24$). Within this range, the most suitable value of Nh was determined following the trial and error approach and the whole spectrum of numbers from 2 to 24 was scanned using the Neuro Intelligence v2.2 (577) software.

As for the function of Naran, the signalal function (sigmatol and hyperbolic logistics) and the cassian function is an unreasonable functional function that can be used on MLL neural networks. However, sigmat and hyperbolic tangen

logistic functions are most commonly used with MLP neurological networks. This study used a supplementary transfer function in the input layers and "indirectly" the voltage of the signal transfer process used for hidden layers, and the "layer" linear transaction function was used for external layers. The network error (square error, SSE) and the rainfall predictions in this network generated very strong positive connections with substantial rain values (r = 0.99), comparing almost 99.8% forecasts in predicted rain rates.

This study area uses the back propagation feed forward neural network with three layers. The structure of the network used is 8-4-1. This network is trained with the following parameters.

Epochs =6000

Performance goal =0.001

Leaching rate = 0.06

Momentum constant =0.4

The normalization of data -1 to 1

The number of iteration 6000

Input Function and Output Function

Input into a node is a weighted sum of outputs from nodes connected to it. The input function is given by the equation: $N_{eti} = \Sigma W_{ij} X_j + \mu_i$

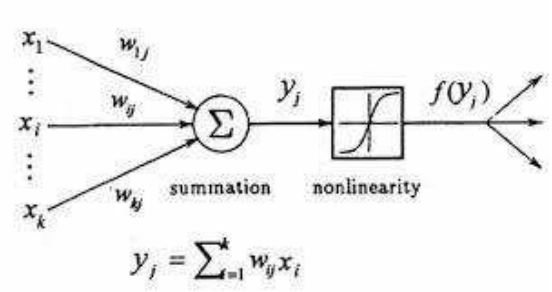

Figure 3: Mathematical Representation of Neural Network

Where Neti describes the result of the net inputs xi (weighted by the weights wij) impacting on unit i. Also wij are weights connecting j to neuron i,x j is output from unit j and μi is the threshold for neuron i, Threshold term is baseline input into to a node in absence of any other input. If a weight wij is negative it is termed inhibitory because it decreases net input,otherwise it is called excitatory. Each unit takes its net input and applies an activation function to it. A number of nonlinear functions have been used in the literature as activation function. The threshold function is useful in situation where the input and outputs are binary encoded. most common choice in activation function is sigmoid function such as

$g(netinput) = [1+ e\text{-}netinput]^{-1}$

$g(netinput) = \tanh(netinput)$

ANN Model

In this study, multi-layer feedback network is used, combined, fully connected and anticipated, an input layer, a hidden layer, and the output layer is used for missing rain. Number of data available for testing 72. The number of neurons in the input and output layers 6 + 1 input parameters are normalized by 0 to 1 in the range later in the range. The optimal configuration and network parameters are identified using the MATLAB ANN toolbox. The model of the disappeared model produced by this network is the most significant positive relationship (r = 0.998) from the beginning to the intermediate and final points. The R-value is an ANN model with the building reflecting the approximate 99.8% (R2 = 0.998) of the estimated variant and emphasizes that the model is well mentioned. The proposed ANN approach is a convenient way to calculate the comparable rainfall with traditional method. As a result, this analysis is an effective tool for ANN to save time and time by computing the prediction of the missing data and calculating the calculation.

This study reports ANN application for a problem that predicts WQV measurements of a surface water system to create a model for IWQI computing and computation. He discussed the common issues related to the design of ANN models. The different potential models are trained and tested on seasonal data of 6 parameters measured for three months using a parallel, fully connected, feed forward network trained using the Gradient descent Back Propagation (BP) learning algorithm.

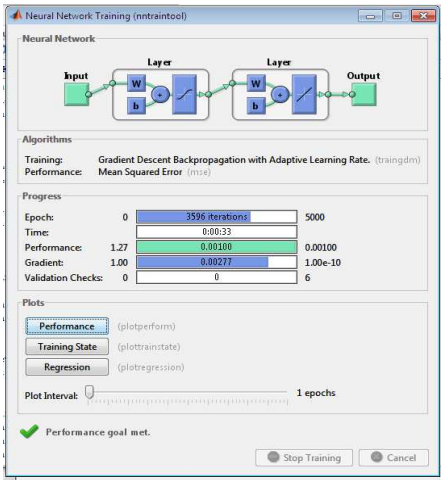

Figure 4: Window Showing Training of ANN

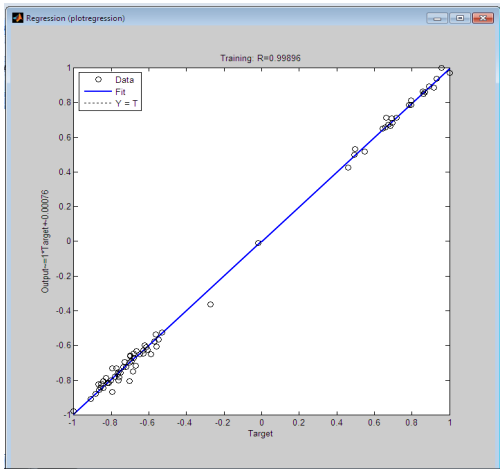

Figure 5: Window Showing Regression Line by ANN

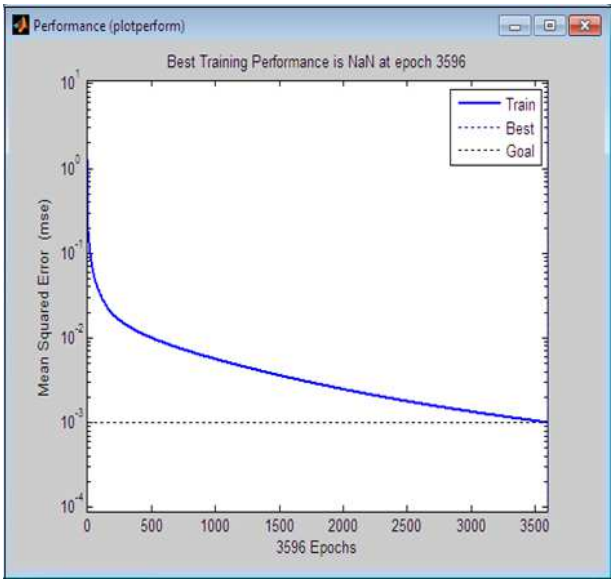

Figure 6: Window Showing Mean Square

Testing and Validation

The performance of predicted data with trained data evaluated with errors such as Mean absolute error (MAPE),the determination coefficient and Mean squared errors.

$$MAPE = \left(\frac{1}{N}\sum_i \left|\frac{t_i - o_i}{t_i}\right| \times 100\right)$$

$$R^2 = 1 - \left(\frac{\sum_i (t_i - o_i)^2}{\sum_i (o_i)^2}\right)$$

.

$$MSE = \left((1/N)\sum_i |t_i - o_i|^2\right)$$

.

Table 1: Predicted and Observed Rainfall

Sl. No	Observed Rainfall in mm	Predicted Rainfall in mm	MAPE	MSE	R^2
1	6	5.9			
2	6.7	6.7			
3	7.2	7.2			
4	6.3	6.3	0.68	0.00	0.99
5	6.3	6.2			
6	7.4	7.4			
7	6	6.0			
8	5.3	5.3			
9	7.3	7.3			
10	5.2	5.2			
11	6.7	4.9998			
12	9.5	5.1999			
13	7.8	6.6998			
14	3.9	9.5008			
15	6.4	7.8045			
16	6.3	3.8838			
17	6.5	6.4			

18	3	6.2919			
19	3	6.5004			
20	3.2	3.0007			
21	3.1	3.0668			
22	5.6	3.0676			
23	3.1	3.0998			
24	5.6	5.5998			
25	3.1	3.0982			
26	2.5	2.5577			
27	2.5	2.4875			
28	2.9	2.8798			
29	3.1	3.0102			
30	3	2.9967			
31	2.9	2.901			
32	3.1	3.0335			
33	3.5	3.5008			
34	2.3	2.2809			
35	2.8	2.8475			
36	2.3	2.2957			
37	3.5	3.5187			
38	2.5	2.5265			
39	3.85	3.9284			
40	3.2	3.2326			
41	2.1	2.1026			
42	3.4	3.3763			
43	2.7	2.7514			
44	2.5	2.5099			
45	3.4	3.4908			
46	3.1	3.0652			
47	3.22	3.2248			
48	3.1	3.1286			
49	3.6	3.6261			
50	2.8	2.7507			
51	3.9	3.8371			
52	4.1	4.0546			
53	4.5	4.47			
54	4.1	4.15			
55	8.7	8.7			
56	8	7.9			
57	8.5	8.5			

CONCLUSIONS

As with traditional statistical approaches, the artificial neural network has been successfully used in various aspects of science and engineering, due to the nature of the linear and linoer systems, without the necessity of creating imagery. When analyzing the literature review, the ANN is better implemented to calculate the smallest rainfall data. A rainy rainfall in several rainy days is estimated using ANN. The R value, with the ANN model, represents 99.8% of the estimated variable value (R2 = 0.998), and emphasizes that the model is well mentioned. Average error rate and average squared error of 0.68.0.00. The findings of these studies make it easier for ANN to change the pattern of rainfall data. The ANN approach offered in this study is recommended as the best, effective and powerful alternative tool for traditional methods of predicting missing data. The findings of this study will be useful for water survey managers and analysts to accept the ANN model as a complete and highly credible alternative to analyzing rainfall issues.

REFERENCES

1. **Guhathakurta, P** *"Long-range monsoon rainfall prediction of2005 for the districts and sub-division Kerala with artificial neuralnetwork": Current Science 90:2006., pp-773-779.*
2. **AfolayanAbimbola Helen, OjokohBolanle A., Falaki Samuel O**, *"Comparative Analysis of Rainfall Prediction ModelsUsing Neural Network and Fuzzy Logic", International Journal of Soft Computing and Engineering (IJSCE) Volume-5 Issue-6, 2016.*
3. **Dastorani, M. T., Moghadamnia, A., Piri, J. & Rico-Ramirez,M. "***Application of ANN and ANFIS models forreconstructing missing flow data". Environment Monitoring Assessment,2009.*
4. **Nkuna, T. R. &Odiyo, J. O. "***Filling of missing rainfall data inLuvuvhu river catchment using artificial neural networks".Journal of Physics and Chemistry of Earth 36, 830–835,2011.*
5. **AfolayanAbimbola Helen, OjokohBolanle A., Falaki Samuel O. "***Comparative Analysis of Rainfall Prediction ModelsUsing Neural Network and Fuzzy Logic",International Journal of Soft Computing and Engineering (IJSCE), Volume-5 Issue-6, 2016.*
6. **Agboola A. H, IyareO,Falaki S.O "***An Artificial NeuralNetwork Model for Rainfall Forecasting in South-Western Nigeria".Canadian Journal on Computing in Mathematics, Natural Sciences,Engineering and Medicine, Vol. 3 No. 6, 2012, pp-188-196.*
7. **Harshanand K. Ghuge, D.G. Regulwar, "***Artificial Neural Network Method For Estimation Ofmissing Data", International Journal of Advanced Technology in Civil Engineering, Volume-2, Issue-1, 2013.*
8. **Deepak RanjanNayak, AmitavMahapatra, Pranati Mishra, "***A Survey on Rainfall Prediction using Artificial Neural Network" International Journal of Computer Applications Volume 72– No.16, 2013.*
9. **Amr H. El-Shafie, A. El-Shafie, Hasan G. El Mazoghi, A. Shehata and Mohd. R. Taha**, *"Artificial neural network technique for rainfall forecasting applied to Alexandria, Egypt", International Journal of the Physical Sciences Vol. 6(6), 2011, pp. 1306–1316.*
10. **Kumar Abhishek, Abhay Kumar, Rajeev Ranjan, Sarthak Kumar**, *"A Rainfall Prediction Model using Artificial Neural Network",IEEE Control and System Graduate Research Colloquium,2012.*
11. **ÖzlemTerzi, EdaÇevik**, *"Rainfall Estimation Using Artificial Neural NetworkMethod", International journal of Technological sciences Vol. 4, No 1, 2012, pp. 10-19.*
12. **Mohini P. Darji, Dharmsinh Desai, Vipul K.***"Rainfall Forecasting Using Neural Network": A Survey Conference Paper, 2015.*
13. *Tomoaki Kashiwao, "A neural network-based local rainfall prediction system using meteorological data on the Internet: A case study using data from the Japan Meteorological Agency",Applied Soft Computing 56, 2017,pp-317–330.*
14. **Mislana*, Haviluddinb *, Sigit Hardwinartoc, Sumaryonod, Marlon Aipassae***"Rainfall Monthly Prediction Based on Artificial Neural Network: A Case Study in Tenggarong Station, East Kalimantan – Indonesia", Procedia Computer Science 59, 2015, 142 – 151,*